REMARKS

The Office Action of December 30, 2003 has been received and its contents carefully considered.

Claims 1 to 5, 13, 15 and 16 are all the claims pending in the application, prior to the present amendment.

Applicants have amended claim 15 so that its terminology is consistent with that of claim 13 from which it depends.

Claims 13-16 have been rejected under 35 U.S.C. § 102(b) as anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as obvious over Kyotani et al.

Applicants submit that Kyotani et al do not disclose or render obviously presently claimed invention and, accordingly, request withdrawal of this rejection.

As set forth in claim 13 as amended above, the present invention is directed to a graphitized carbon fiber obtained by a high temperature heat treatment method for vapor grown carbon fiber which has been produced through thermal decomposition reaction of a carbon source and a transition metal catalyst, serving as main raw materials, which method comprises vaporizing a metal impurity contained in the carbon fiber, and discharging to outside of a heat treatment furnace the impurity through a vicinity of a highest-temperature section of the furnace while being accompanied by a carrier gas, wherein the obtained carbon fiber comprises about 30 ppm or more to 100 ppm or less of a metal element selected from the group consisting of Fe, Ni or Co.

Thus, applicants have amended claim 13 to recite that the present invention is directed to a graphitized carbon fiber obtained by a high temperature heat method for vapor grown carbon fiber, wherein a metal impurity contained in the carbon fiber is vaporized, the result of which is a carbon fiber containing 30 ppm or more to 100 ppm or less of a metal impurity. In addition, applicant has added a new dependent claim 17 which states that the impurity is Fe. Support for these amendments can be found in Examples 1 and 2.

The carbon fibers of claim 13 of the present invention differ from conventional carbon fibers described at page 2 of the specification in that the carbon fiber of the present invention is, as described, for example, in Example 1, a carbon fiber having, for example, an Fe amount of 30 mass ppm (that is, about 100 ppm or less of a metal element) obtained after removing impurities from the gas outlet 25 positioned in the vicinity of the highest-temperature section in the furnace of an apparatus shown in Fig. 4, whereas conventional carbon fibers are a carbon fiber having an Fe amount of, for example, 200 mass ppm, as shown in the Comparative Example of the present specification, after removing impurities from the gas outlet 5 positioned at the low-temperature end in the furnace of the apparatus shown in Fig. 2.

The heat treatment temperatures that were employed in Example 1 and the Comparative Example were the same, namely, 2800°C. This difference in the carbon fibers seems to be attributable to the difference in the temperature distribution inside the heat-treatment furnace where the temperature is higher in the center portion as compared with the vicinity of the inlet of the heat-treatment furnace, and as a result, in the present invention impurities (metal

components) can be efficiently discharged without being solidified. See page 9, lines 14 to 30 of the present specification.

Furthermore, in the removal of metal impurities according to the present invention, the percentage removal increases as the heat-treatment time (in the furnace) and the flow rate of carrier gas increase. Therefore, parameters such as heat treatment time and carrier gas flow rate may be determined by taking account of the required impurity standard for the vapor grown carbon fiber. See page 10, lines 2 to 6 of the present specification.

The Kyotani et al article discloses a carbon nanotube obtained by a method of using a template, but not using a transition metal as the catalyst. The obtained carbon nanotube comprises a single hollow tube, with both ends being opened.

Kyotani et al do not describe any amount of impurities. Since Kyotani et al do not employ a metal catalyst in their method for making carbon tubes, applicants submit that one or ordinary skill in the art would expect that the carbon tubes of Kyotani et al do not contain any metal element derived from the catalyst. In contrast, in the present invention, since a metal catalyst is employed, a metal element is present as an impurity. In the past, metal impurity elements from use of a metal catalyst have been present in carbon fibers in relatively high amounts, such as 200 ppm. See the Comparative Example of the present specification. The present invention, however, has been able to provide a carbon fiber that, while still containing a metal impurity, contains such an impurity in a reduced amount. Kyotani et al do not disclose or suggest such a carbon fiber.

In view of the above, applicants submit that Kyotani et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

Claims 13-16 have been rejected under 35 U.S.C. § 102(e) as anticipated by, or in the alternative under 35 U.S.C. § 103(a) as obvious over Tennent et al.

Applicants submit that Tennent et al do not disclose or render obviously presently claimed invention and, accordingly, request withdrawal of this rejection.

The Examiner states that he is relying on the discussion of vapor grown carbon fibers that appears in column 2 of Tennent et al.

In the Amendment Under 37 C.F.R. § 1.111 filed on October 14, 2003, applicants argued that the carbon fiber described in claim 1 of Tennent et al do not disclose or suggest the carbon fiber of the present invention. The Examiner, however, states that he is not relying on this portion of Tennent et al, but is relying on the disclosure at column 2, lines 32-52, where Tennent et al disclose a heat treatment of 2500 - 3000°C in a prior art method of making carbon filaments. The Examiner concludes that this heat treatment would result in the same carbon fibers as set forth in the present claims.

The description at column 2 of Tennent et al does not set forth any details on the method of the heat treatment. Tennent et al do disclose that a metal catalyst particle is employed. Therefore, since Tennent et al disclose a metal catalyst, it would be expected that the fiber filament disclosed at column 2 would contain metal impurity, and that since Tennent et al do not disclose the specific heat treatment set forth in the present claims, the fiber filaments described in

Tennent et al would be expected to have a metal content of more than 100 ppm, such as illustrated in the Comparative Example of the present specification.

In view of the above, applicants submit that Tennent et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

Claims 13-16 have been rejected under 35 U.S.C. § 102(b) as anticipated by, or in the alternative, under 35 U.S.C. § 102(a) as obvious over Harada et al.

Applicants submit that Harada et al do not disclose or render obviously presently claimed invention and, accordingly, request withdrawal of this rejection.

Again, as discussed above, the carbon fibers of claim 13 of the present invention differ from conventional carbon fibers described at page 2 of the specification in that the carbon fiber of the present invention is, as described, for example, in Example 1, a carbon fiber having, for example, an Fe amount of 30 mass ppm (that is, about 100 ppm or less of a metal element) obtained after removing impurities from the gas outlet 25 positioned in the vicinity of the highest-temperature section in the furnace of an apparatus shown in Fig. 4, whereas conventional carbon fibers are a carbon fiber having an Fe amount of, for example, 200 mass ppm, as shown in the Comparative Example of the present specification, after removing impurities from the gas outlet 5 positioned at the low-temperature end in the furnace of the apparatus shown in Fig. 2.

The heat treatment temperatures that were employed in Example 1 and the Comparative Example were the same, namely, 2800°C. This difference in the carbon fibers seems to be attributable to the difference in the temperature distribution inside the heat-treatment furnace where the temperature is higher in the center portion as compared with the vicinity of the inlet of

the heat-treatment furnace, and as a result, in the present invention impurities (metal components) can be efficiently discharged without being solidified. See page 9, lines 14 to 30 of the present specification.

Furthermore, in the removal of metal impurities according to the present invention, the percentage removal increases as the heat-treatment time (in the furnace) and the flow rate of carrier gas increase. Therefore, parameters such as heat treatment time and carrier gas flow rate may be determined by taking account of the required impurity standard for the vapor grown carbon fiber. See page 10, lines 2 to 6 of the present specification.

Harada et al describe, in claim 1, a vapor grown and graphitized carbon fiber having a spin density of $8x10^{18}$ spins/g or less as measured by the electron spin resonance absorption method. This spin density value does not mean the amount of metal impurities, but as described in column 5, lines 44 to 49, this corresponds to the amount of oxygen radical with a g value of 2.015.

In Harada et al, the reason for bringing about a decrease in the oxygen radical shown by the decrease of spin density is described in column 7, lines 14 to 28. The vapor grown carbon fiber of Harada et al is specified by the oxygen radical amount. However, Harada et al do not describe or suggest the amount of metal impurities.

Harada et al disclose performing a heat-treatment (graphitization) at 2000°C or more. However, Harada et al neither teach nor suggest how the impurities are removed, and how a vapor grown carbon fiber reduced in metal impurities can be obtained. By mere heat treatment at a high temperature, the amount of metal impurities does not decrease to 100 ppm or less, as

proved in the Comparative Example of the present specification. See page 13, lines 5 to 6 of the present specification, which shows that a heat treatment at 2800°C in a conventional furnace, instead of the 2800°C heat treatment in Example 1 of the present specification, resulted in an Fe impurity amount of 200 ppm as compared to the 30 ppm impurity amount in Example 1.

The Examiner acknowledges that applicants have argued that the Comparative Example in the present specification proves that high temperature heat treatment other than by the method of Example 1 results in a metal content greater than 100 ppm.

The Examiner states, however, that this assumes that the same initial concentration of metal is employed in Harada et al.

The Examiner further states that the Comparative Example in the specification discloses that the furnace in which the high temperature heating takes place was destroyed. The Examiner argues that this destruction of the furnace does not occur in a process of Harada et al because no mention is made to it in the Harada et al patent.

Harada et al disclose that the vapor grown fibers can be prepared by a vapor phase method, which can be substrate method or the fluidized growth method, both of which are disclosed by Harada et al as employing a metal catalyst. See column 4, line 51 to column 5, line 11. See also, column 1, lines 26 to 32, where Harada et al refer to an iron or nickel catalyst. Harada et al do not provide any details on the subsequent heat treatment to bring about graphitization, except that the heat treatment is at a temperature of 2000°C or higher. In Example 1 of Harada et al, the temperature was 2800°C for 30 minutes.

Harada et al do not disclose the concentration of metal in the vapor grown fiber prior to or subsequent to graphitization. Accordingly, applicants submit that it is impossible to provide a direct comparison based on Harada et al, since Harada et al do not disclose the amount of metal element. Applicants submit that the Comparative Example is an appropriate comparison, since Harada et al do not disclose the amount of catalyst in the vapor grown fiber, and an appropriate comparison, therefore, is one in which the starting amounts are the same, as in Example 1 and the Comparative Example of the present specification.

Further, with respect to the Examiner's comment that since Harada et al do not disclose the destruction of the furnace, it is expected that the Harada et al furnace is not destroyed, applicants point out that Harada et al do not provide any details on the furnace. Therefore, applicants submit that no conclusions can be arrived at from the Harada et al disclosure concerning destruction of the furnace.

In view of the above, applicants submit that Harada et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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